```
# Import necessary libraries
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn.metrics import mean_squared_error, r2_score
```

```
# Load the Wine Quality dataset (you can download it from various sources)
wine_data = pd.read_csv("WineQT.csv")
```

```
# Print the first 5 rows of the dataframe.
wine_data.head()
```

```
.dataframe tbody tr th {
    vertical-align: top;
}

.dataframe thead th {
    text-align: right;
}
```

	fixed acidity	volatile acidity	citric acid	residual sugar	chlorides	free sulfur dioxide	total sulfur dioxide	density	pH	sulphates	alcohol	quality	Id
0	7.4	0.70	0.00	1.9	0.076	11.0	34.0	0.9978	3.51	0.56	9.4	5	0
1	7.8	0.88	0.00	2.6	0.098	25.0	67.0	0.9968	3.20	0.68	9.8	5	1
2	7.8	0.76	0.04	2.3	0.092	15.0	54.0	0.9970	3.26	0.65	9.8	5	2
3	11.2	0.28	0.56	1.9	0.075	17.0	60.0	0.9980	3.16	0.58	9.8	6	3
4	7.4	0.70	0.00	1.9	0.076	11.0	34.0	0.9978	3.51	0.56	9.4	5	4

```
# Shape of the dataset
wine_data.shape
```

```
(1143, 13)
```

```
# Select the features (independent variables) and target variable (dependent variable)
X = wine_data.drop("quality", axis=1)
y = wine_data["quality"]
```

```
# Split the dataset into a training set and a testing set
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)
```

Model Selection and Evaluation

```
model = LinearRegression()
```

```
model.fit(X_train, y_train)
```

```
▾ LinearRegression
LinearRegression()
```

```
# Print the intercept
print("Intercept:", model.intercept_)
# Print the coefficients
print("Coefficients:", model.coef_)
# Print the R-squared value for the model
print("R-Squared:", model.score(X_train, y_train))
```

```
Intercept: 36.49622742034098
Coefficients: [ 4.48281781e-02 -1.32650965e+00 -3.20227391e-01  4.64672501e-03
 -1.83692523e+00  2.78901313e-03 -2.58694082e-03 -3.27678330e+01
 -2.84072230e-01  9.53929276e-01  2.71613626e-01 -7.20729446e-05]
R-Squared: 0.38350132469569986
```

```
# Predict the values of the testing set
y_pred = model.predict(X_test)
```

```
# Print the predicted values
print("Predicted values:", y_pred)
# Print the actual values
print("Actual values:", y_test.values)
```

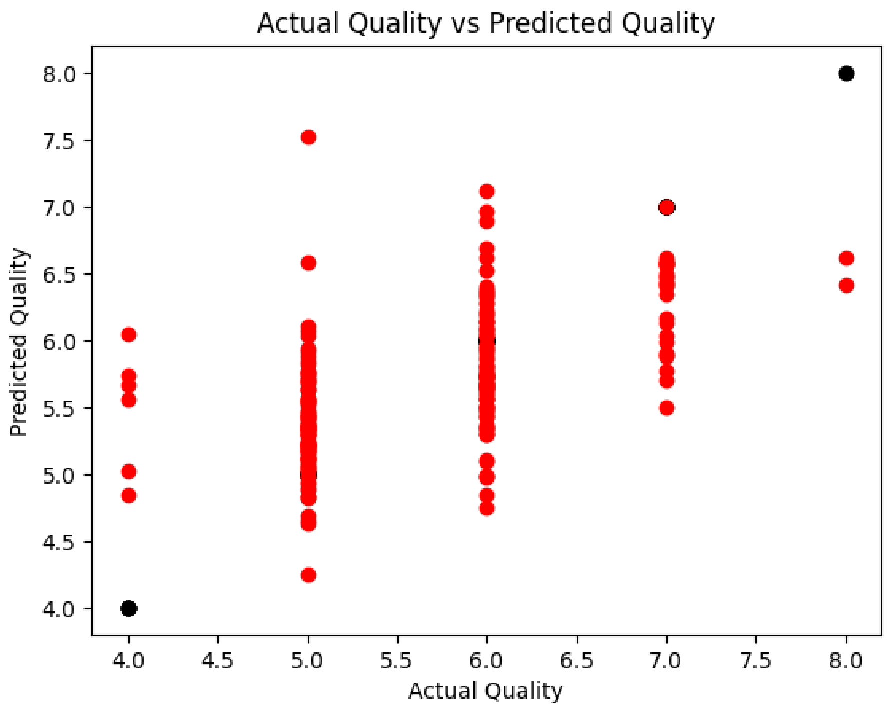
```
Predicted values: [5.42239406 4.75039315 5.29684786 5.08885868 6.09486333 6.61357779
 5.4017609  5.12073623 5.80682335 5.32701664 6.34740954 6.36404342
 5.30874791 6.20726473 5.82424736 4.84564054 5.6866377  5.69867218
 5.46145685 6.40788444 6.03767614 6.03147727 5.20921387 6.48042456
 5.62504152 5.15767898 6.56630591 5.96162446 5.13243268 5.55393556
 6.22138034 5.50621416 6.61300256 5.72900211 5.57167536 5.30091294
 5.50270472 6.03438174 6.9574108  6.57721823 6.44071484 5.36204407
 7.11515613 5.3357927  5.02045693 5.1019234  5.66565116 5.86060262
 4.62611376 5.64639624 6.43111192 5.3070245  5.66220358 5.90248884
 5.7764028  6.40204632 5.49239433 5.66938259 6.05514973 5.22988268
 5.53032108 5.94808156 5.64622439 6.32047068 6.13819951 5.42307061
 6.88637688 5.23198061 4.89240584 5.94146638 5.72706586 5.36371717
 5.87330383 5.930108   5.20816681 5.18102988 5.84084001 5.87519663
 5.56537843 5.44033853 5.40608755 5.55643832 6.10128776 5.29822848
 5.49734983 6.03451096 5.34687089 5.6974897  5.72681184 5.29496201
 4.68397464 5.55695274 4.97804761 5.17647692 5.01828612 5.16874364
 5.33114803 6.62399797 5.93894188 5.60837069 5.69732096 6.37610023
 5.22035641 6.13830344 5.25352322 5.34490929 5.89277194 6.16666685
 5.58668514 6.56645076 5.98169489 5.29184041 5.4800231  6.0294004
 4.99093382 5.061652   5.33473638 6.42138353 5.7626642  4.82928225
```

```
 5.20620271 4.96992829 5.63039297 6.68734369 5.12155877 5.7081158
 5.74711888 5.73377378 4.98836899 6.34104493 5.09344585 4.92429433
 5.88902841 5.72761173 7.5251219  4.65411865 4.25272645 5.55340939
 5.54525202 5.73382194 6.99983494 5.34624769 5.6573963  4.87519337
 6.40987969 5.18446797 5.04901513 5.43076086 4.81623232 4.9340132
 6.58731777 5.42349931 6.33687426 5.33430743 5.91097736 5.67419869
 5.43068878 5.76187551 6.13328002 5.68231322 5.91201742 4.98545116
 5.7301566  5.6295802  5.76982625 5.350188   6.09995296 6.04911622
 5.60937534 5.2085794  6.52465666 5.36957031 5.43705669 5.63973057
 5.36744872 5.1815714  6.47092085 6.07255401 5.65482782 5.371954
 6.07147777 5.75435623 5.63932537 5.36143138 5.214711   5.56330047
 6.27852249 4.83213573 6.35160548 5.73281137 5.7290187  5.80131083
 6.55905346 5.82571986 5.54739967 5.46248875 5.04360668 6.57158693
 6.59359174 6.28008716 5.68938741 5.77881181 5.27959543 5.53932248
 5.88377579 5.50233434 5.217547   5.22908917 6.18210143 6.20384406
 5.1234562  6.12960094 5.50725131 5.67769048 5.50584127 5.10162049
 6.49869588 5.06768797 6.08294074 5.79419084 5.67068135 5.45333428
 5.0281772  5.74321052 4.8459337  6.13966888 5.36275274 5.47705627
 5.7460512 ]
Actual values: [5 6 5 6 6 8 5 5 6 5 7 6 6 6 5 6 5 5 5 6 6 6 5 7 6 5 7 6 5 6 6 6 6 5 6 5 6
 7 6 5 7 5 6 5 4 5 6 6 5 6 7 5 6 7 5 7 6 4 6 5 5 6 5 6 6 6 6 5 5 5 6 5 6 6
 5 5 5 5 5 6 5 6 5 6 6 6 6 5 6 6 5 5 6 5 5 5 6 7 6 6 7 6 5 6 5 5 6 7 6 7 7
 5 5 5 6 5 5 8 6 5 5 5 5 6 5 6 6 6 6 6 5 5 7 6 5 5 5 6 5 6 7 6 6 5 7 5 5 5
 5 5 7 6 6 5 6 6 5 5 7 5 5 5 6 5 7 5 6 4 6 5 6 5 5 6 5 5 7 5 6 6 6 5 6 6 5
 4 6 5 6 4 6 6 7 6 5 6 5 7 7 6 6 6 5 5 7 7 5 5 6 6 5 6 6 6 5 6 7 5 6 6 6 5
 5 5 4 6 5 6 6]
```

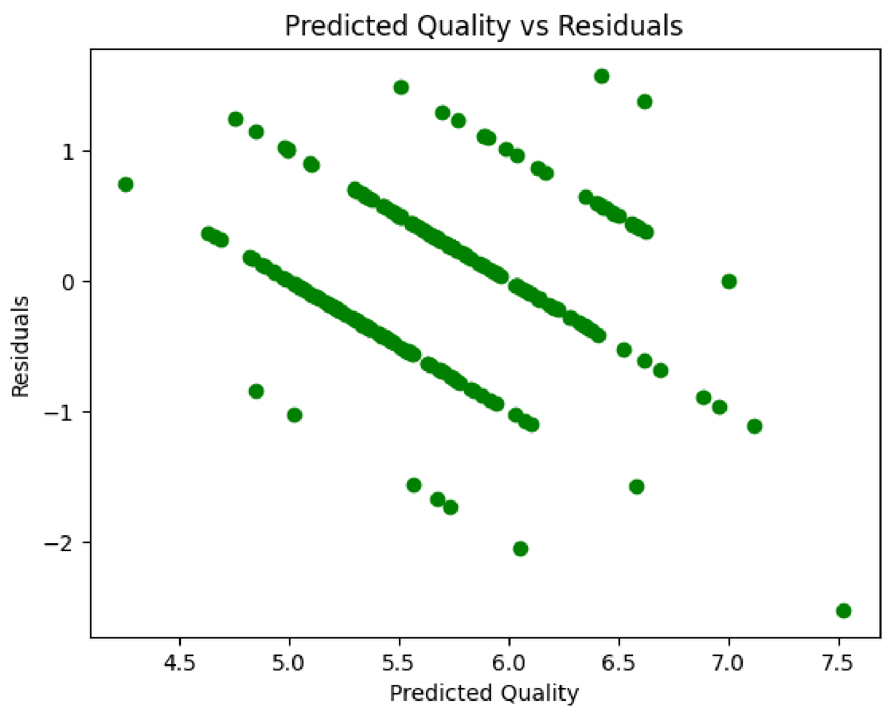
```python
# Evaluate the model using Mean Squared Error
print("Mean Squared Error:", mean_squared_error(y_test, y_pred))
# Evaluate the model using R-squared value
print("R-Squared:", r2_score(y_test, y_pred))
```

```
Mean Squared Error: 0.3824283521291851
R-Squared: 0.31276385395084005
```

```python
# Plot the actual values
plt.scatter(y_test, y_test, color="black")
# Plot the predicted values
plt.scatter(y_test, y_pred, color="red")
plt.xlabel("Actual Quality")
plt.ylabel("Predicted Quality")
plt.title("Actual Quality vs Predicted Quality")
plt.show()
```




```
# Plot the residuals
plt.scatter(y_pred, y_test - y_pred, color="green")
plt.xlabel("Predicted Quality")
plt.ylabel("Residuals")
plt.title("Predicted Quality vs Residuals")
plt.show()
```




```
# Accuracy of the model
print("Accuracy of the model:", model.score(X_test, y_test))
```

```
Accuracy of the model: 0.31276385395084005
```

```python
from sklearn.metrics import accuracy_score, classification_report

# Convert the predicted values to integers
y_pred = y_pred.astype(int)

# Print the classification report
print(classification_report(y_test, y_pred))

# Print the accuracy of the model
print("Accuracy of the model:", accuracy_score(y_test, y_pred))
```

```
              precision    recall  f1-score   support

           4       0.05      0.17      0.08         6
           5       0.51      0.81      0.63        96
           6       0.54      0.30      0.39        99
           7       0.00      0.00      0.00        26
           8       0.00      0.00      0.00         2

    accuracy                           0.48       229
   macro avg       0.22      0.26      0.22       229
weighted avg       0.45      0.48      0.43       229

Accuracy of the model: 0.4759825327510917


C:\Users\anish\AppData\Local\Packages\PythonSoftwareFoundation.Python.3.11_qbz5n2kfra8p0\LocalCache\local-packages\Python311\site-packages\sklearn\metrics\_classification.py:1469: UndefinedMetricWarning: Precision and F-score are ill-defined and being set to 0.0 in labels with no predicted samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
C:\Users\anish\AppData\Local\Packages\PythonSoftwareFoundation.Python.3.11_qbz5n2kfra8p0\LocalCache\local-packages\Python311\site-packages\sklearn\metrics\_classification.py:1469: UndefinedMetricWarning: Precision and F-score are ill-defined and being set to 0.0 in labels with no predicted samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
C:\Users\anish\AppData\Local\Packages\PythonSoftwareFoundation.Python.3.11_qbz5n2kfra8p0\LocalCache\local-packages\Python311\site-packages\sklearn\metrics\_classification.py:1469: UndefinedMetricWarning: Precision and F-score are ill-defined and being set to 0.0 in labels with no predicted samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
```